comes the independent State of Nepal, of which nothing at all is known, and it is only in the British territory and the native States under British control at the north-western extremity of the range that the geology is known, even approximately. There is, consequently, a tendency to extend the knowledge of this region to the rest of the range, and to draw conclusions which are only doubtfully applicable.

This tendency has not altogether been avoided, and the lengthy discussion of the age of the unfossiliferous sedimentary rocks of the Simla region seems to give this subject an importance which it does not possess, especially as, in the end, it is left in a state of little less uncertainty than before. The only clue to the age of these rocks is the fact that they contain a series of beds, the Blaini, which is generally acknowledged to present unmistakable signs of glacial origin. At one time this series was regarded as of Permian age, but this explanation is rejected, and the Blaini series is correlated with the pre-Cambrian glaciation which has been studied and described in Africa, China, Australia, and, we may add, in Norway. Mr. Hayden argues with great plausibility that the complete absence of any trace of fossils in a great thickness of rocks, which might well be expected to contain them, and their abundance in the great series of deposits on the other side of the snowy range, is more reasonably explained by a difference in age than in conditions of deposition. This reasoning we may accept, and acknowledge that the Blaini tillites are more probably pre-Cambrian than Permian in age, but the possibility that the rocks of the Simla area are a flysch facies of the fossiliferous sediments of Spiti must be borne in mind, and, until less equivocal evidence is adduced, the problem must remain unsolved.

With this exception the work is a well-balanced summary of the geology of the Himalayas, useful to those who wish to have the leading facts put briefly and clearly, and also, by the copious references to original authorities, invaluable as a guide to more detailed study.

Elementary Physiology for Teachers and Others. By W. B. Drummond. Pp. viii+198; illustrated. (London: Edward Arnold, 1909.) Price 2*s.* 6*d.*

THIS is a useful little book of its kind, elementary, as its title implies, and correct in its details, an element so often lacking in similar works. Like other books of its class, it necessarily contains a good deal of what is anatomy rather than physiology, and it chiefly differs from its competitors in pointing out the applications of physiology in the health, well-being, and training of children. This is by no means an unimportant point, seeing that the work is written for school teachers. W. D. H.

Evolution: A General Sketch from Nebula to Man. By Joseph McCabe. Pp. vii+128. (London: Milner and Company, Ltd., n.d.) Price 1*s.* net.

THE author of this little book defines his aim as being "chiefly to present a panoramic view of the development of the world—especially the world that lies close about us—by a conscientious use of the results of many sciences, and aided by a personal acquaintance during many years with both telescope and microscope." The style is interesting, and the slight sketch provided may send a few general readers to first-hand authorities for further information. The language is not always precise; for instance, we find "refractory liquid fire," "a lowering of climate," and so on; but on the whole the volume may serve a useful purpose by introducing non-scientific readers to some problems of inorganic and organic evolution.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Magnetic Storms and Solar Eruptions.

REFERRING back to the *Electrician* of nine years ago (December 7, 1900), I find that, following up a suggestion of G. F. FitzGerald made in 1893, I promulgated a view of major magnetic storms which events have confirmed. See, for instance, Mr. Maunder's paper in Mon. Not. R.A.S. for 1904, vol. lxv., p. 33.

What I have to point out is that a stream or beam of electrons ejected from the sun and passing near or over the earth would cause magnetic perturbations of the kind required—positive as it approached, zero as it passed over, negative as it receded; with many minor disturbances superposed due to variations of density, as well as others due to the effect of particles caught by the atmosphere.

Such a beam or stream of electrified particles is essentially a magnetic cyclone, and the changes in magnetic force as it travels past any locality bear a fairly close analogy with the changes in wind-velocity during the passage of an atmospheric cyclone.

The relative speed of such a solar beam, as it overtakes the earth, follows from the sun's angular velocity, and is 210 miles a second.

Earth currents would, in the main, be induced as it approached and checked as it receded.

The rotation of the earth in the magnetic field of such a stream is too slow to be effective: though locally in the neighbourhood of six o'clock an intense ray of the main beam might generate east and west currents.

Now magnetic disturbances recorded during the recent storm, and quoted by Dr. Chree in the *Times* and elsewhere, indicate a declination deflection of $1\frac{1}{2}$ degrees, followed by a reversed deflection of the same amount—all within a quarter of an hour.

This means—on the above theory—that the main beam took this time to traverse the place, so that the breadth of the beam was comparable to twenty times the earth's diameter. No doubt it is diffused, at this distance from the sun, by internal repulsion of the particles.

The intensity of field which would give the above deflection is approximately one-fortieth of that of the earth's horizontal intensity, or, say, 0·004 C.G.S., as the order of magnitude.

Taking these data, together with the known charge and velocity of electrons in kathode rays—say $e=10^{-20}$ electromagnetic C.G.S. units, $u=10^9$ centimetres per second—let us reckon the closeness of the crowd of particles in the beam necessary to account for the observed force.

The magnetic intensity at any place, distant r from the axis of a linear stream of sectional radius a and current density γ, is given by the following expressions:—

$$H=\frac{2C}{r}$$
$$C=\pi a^2\gamma$$
$$\gamma=n_1 eu,$$

where n_1 is the number of particles per cubic centimetre of the stream.

This gives

$$n_1=\frac{rH}{2\pi a^2 eu},$$

so taking a place just grazed by the beam, so that $r=a=20\times 2/\pi\times 10^9$, and putting in the other data just cited, we get

$$n_1=\frac{0\cdot004}{80\times 10^9\times 10^{-11}}$$
$$=0\cdot005 \text{ per c.c.},$$

or, say, five electrons per litre, on the average, all through the beam. I regard this as a modest and not unlikely estimate of crowdedness. The amount of matter ejected from the sun in this beam is insignificant, being less than a couple of tons per week.

The total current equivalent of such a beam is six

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hundred thousand amperes—which again is rather surprisingly moderate, and leaves plenty of margin for underestimate of disturbance and for local perturbations too great for the instruments.

I send this little calculation because some doubt has been expressed as to whether the magnetic effect of a solar stream would be adequate to explain observed facts. It appears to me in general outline to be ample, both in amount and kind. OLIVER LODGE.

University of Birmingham, October 4.

The Magnetic Storm.

SOME details of the magnetic variations during a period including the great magnetic storm of September 25 may be of interest to the readers of NATURE.

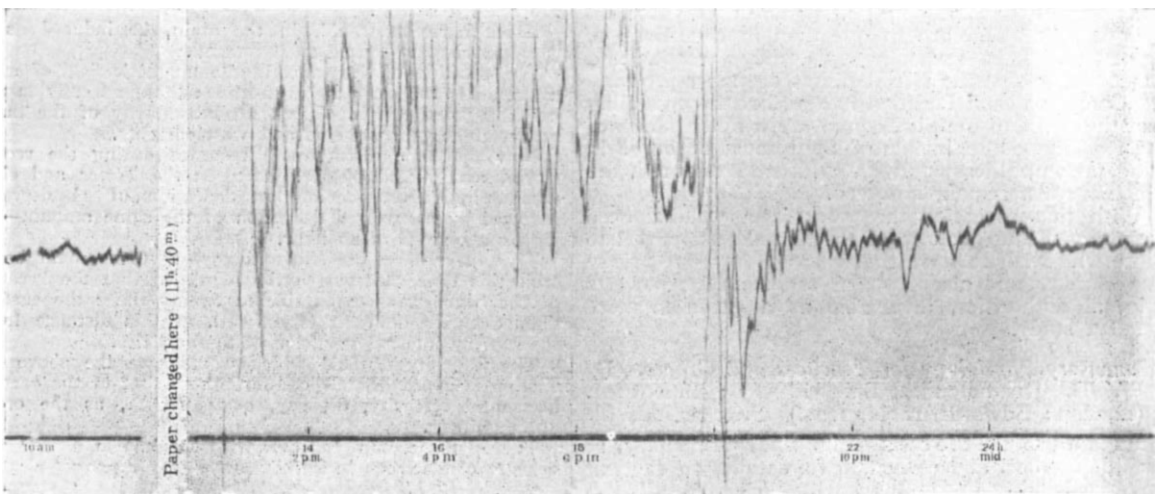
From the beginning of the month the magnets were comparatively quiet, disturbed from a state of calm only by small oscillations, increasing somewhat on September 7, 8, and 15 until September 21, when a greater disturbance was recorded between noon and midnight. This was followed by an approximate calm until 8.30 a.m. of September 25, when the coming storm was foreshadowed by a sudden small dip in the curves of the declination and horizontal-force magnets, and a slower fall of vertical-force curve, indicating an eastward movement in declination and a diminution of the two components of force. The preliminary oscillations thus started remained small, averaging about 10′ of arc on both the declination and horizontal-force curves until some time between 11.40 a.m. and noon, whilst the films were being changed. It is, therefore, not clear on which side of the film the spot of light was carried away by the first great deflection; but in declination it remained off the paper until 11.40 a.m., when it was found returning from the east, while the horizontal force had already recovered, and, together with the vertical force, was showing a rapidly increasing intensity.

The general deflection in declination was westward throughout the storm, with many rapid moves off the film, and only two violent throws to the east, one at the commencement and the other at the end of the storm, the latter being a swing across the film from the extreme west edge over the east edge in less than two minutes of time, covering more than $2\frac{3}{4}$ degrees. An equally great and rapid movement on the horizontal-force curve took place at the same time near the close of the storm, with increase of the component force, and the vertical-force balance finally heeled over through loss of force.

The storm seems to have been at its height between 3.30 and 5.30 p.m., when the light spots of all three instruments were, for the most part, off the papers, and ended at 8.30 p.m. It was followed by smaller rapid oscillations of the declination and horizontal-force needles until midnight, when the small after-tremors commenced, and continued until about 6 p.m. of September 27.

The seismologist cannot fail to see in these three phases of oscillation an imitation of the pendular swings produced by a distant earthquake, and the preliminary movements are undoubtedly of the first interest to the student of terrestrial magnetism. The suggestion is very pointed that, whatever be the cause of the magnetic storm, it must be something arriving in our neighbourhood, whether directly from the sun or circulating round it, of which a part travels quicker and has less effect than the slower moving particles which produce the great oscillations; but we are in no position to meet the difficulties which beset any definite supposition as to the nature of these particles, and defend it against the apparent contradictions which assail it. WALTER SIDGREAVES.

September 28.



Declination Magnetogram, Stonyhurst College Observatory, September 25, 1909.

THE MEETING OF THE INTERNATIONAL GEODETIC ASSOCIATION IN LONDON AND CAMBRIDGE.

THE meeting which began in London on Tuesday, September 21, and ended in Cambridge on September 30, has been notable in several respects. Great Britain joined the International Geodetic Association only twelve years ago. The triennial meeting has been held this year for the first time in England, and for the first time Greater Britain has been represented by special delegates from the Governments of India, Australia, and Canada; Chili has become a member of the association and sent a representative; and the Egyptian Government has been represented by one of the British officers of the Survey Department. The London meeting marks, then, a broadening of the interests of the association on the political and administrative side; on the scientific side it has been remarkable for the extremely interesting reports upon the special problems of the internal constitution of the earth and the lunar earth-tides.

About fifty delegates, from twenty nations, were appointed to represent their respective Governments, and came to the congress, which held its London meetings in the handsome apartments of the Institution of Civil Engineers, kindly placed at the disposal of the British representative. A large part of the business of the association consists in the reception and adoption of general reports of a highly condensed and technical character, impossible to summarise.

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